THE EFFECT OF *STOP LINE* MARKINGS ON THESAFETY OF AIRCRAFT MOVEMENT ON THE *APRON*

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Abstract
Sam Ratulangi International Airport Manado is a class 1B airport and the second largest on the island of Sulawesi after Sultan Hasanuddin International Airport Makassar. This airport has scheduled flights of around 20-25 flights per day both domestic and international routes. This led to a lot of aircraft movement. Markings on the apron are very important to ensure the safety of aircraft movement, one of which is the stop line mark as a marker of the stopping position of the aircraft. The purpose of this study is to determine the suitability of stop line markings on the apron to applicable regulations and their effect on the safety of aircraft movement if there is a marking's discrepancy. The research methodused is descriptive qualitative, namely the collection of data and information through observation, interviews, and literature studies to then be processed in more detail to get clearer data results. The results of this study found that there was a discrepancy in the stop line markings on the apron of Sam Ratulangi International Airport Manado on parking stands 7, 8, and 9 and this was quite influential on the safety of aircraft movement if the aircraft parked on the wrong stop line, which caused difficulty in the aviobridge docking process to the plane. To overcome this problem is by briefing the marshaller team for adjustment of the aircraft parking position and for the long term is to evaluate the markings then remove the old markings that are not suitable and repaint the new markings in accordance with current regulations and conditions.

Keywords: stop line marking, apron, aircraft parking, airport

INTRODUCTION

Sam Ratulangi International Airport Manado, is a class IB airport located in Mapanget District, 13 kilometers northeast of Manado City, North Sulawesi. Sam Ratulangi International Airport Manado is the second largest airport on Sulawesi Island after Sultan Hasanuddin Airport Makassar and is the 16th busiest airport in Indonesia according to the Get To Center Site. In 2022, the total passenger movement at this airport is 3,671,997 passengers. Quoting from the flightradar24.com website, starting from December 24, 2022 to January 22, 2023, this airport serves scheduled flights totaling 597 flights with the busiest flights on Wednesday, January 18, 2023.

In order to achieve regularity and safety of aircraft movement on *the apron*, each airport must comply with regulations through one of which is the Regulation of the Minister of Transportation Number KM 21 of 2005 concerning the Implementation of Indonesian National Standards (SNI) 03-7095-2005 concerning Markings and Signs in the Area of Aircraft Movement at the Airport as a Mandatory Standard [1]. This regulation is a guideline for an airport in making standard markings and signs in the area of aircraft movement at the airport so that flight activities, especially when on the *apron* and surrounding areas, can run smoothly and flight safety can be maintained.

Through initial observations made by the author, the markings owned by Sam Ratulangi International Airport Manado are complete and according to standards ranging from the apron, taxiway to runway. It's just that there is ambiguity on the apron side where there is a discrepancy in the stop line marking, namely the lack of aircraft type design markings which can cause errors in the placement of the nose wheel and affect the accuracy of the aviobridge position in the docking process to the aircraft.

The first problem found was that there were aircraft stand markings on parking stand 8 that overlapped for flexible use, but did not have aircraft type identification so that it could lead to confusion if the wrong markings were followed. The second finding on parking stand 8 is also the lack of aircraft type design markings on the aircraft stand which has three stop lines and there is

inappropriate aircraft identification writing on the stop line. The third finding on parking stand 9 is that there are two stop line marshaller markings on one aircraft stand that have the same aircraft type design (B737) which can cause ambiguity. The findings of this problem are based on theory [2]; [3]; [4]; [5]; about markings in the movement area (apron).

According [6]; [7]; [8]; [9]; [10] Markings on the air side provide important information for pilots and must be clearly visible to support aircraft movement on the ground and aircraft parking. Globally, the aviation industry agrees on the importance of effective marking systems as a vital component in the safety of aviation navigation on the ground [11]. Markings on runways, taxiways and aprons play an important role in preventing runway incursions, over time the markings will fade and deteriorate in clarity so they must be replaced over time [12].

In flight operations, AMC personnel have an important role in arranging aircraft parking because they have the responsibility to ensure the security, smoothness and safety of aircraft on the apron [13]. Therefore, markings in the area of movement are a concern for AMC personnel in order to create order and safety of aircraft movement.

Based on the background description of the problem above, the author can compile the formulation of existing problems, namely:

1. Are the stop line markings on the apron of Sam Ratulangi International Airport Manado in accordance with applicable regulations?
2. Do stop line *markings* that are not in accordance with regulations affect the safety of aircraft movement?

METHOD

Research Design

The research method used by the author is descriptive qualitative by focusing on a detailed understanding of a problem. The emphasis on this method is on the quality of the clear picture. This method describes the meaning and experience of the author's subject to a situation that cannot be measured numerically. Qualitative research used to explores the opinion of the participants about the problem, observation, and documentation [14].

According to Creswell, defines qualitative research methods as an approach or tracing to explore and understand a symptom centrally. To find out these symptoms, researchers conducted interviews with participants by asking questions that were general and rather broad. Then information in the form of words or text submitted by participants is collected for analysis. The result of the analysis can be a depiction or description [15].

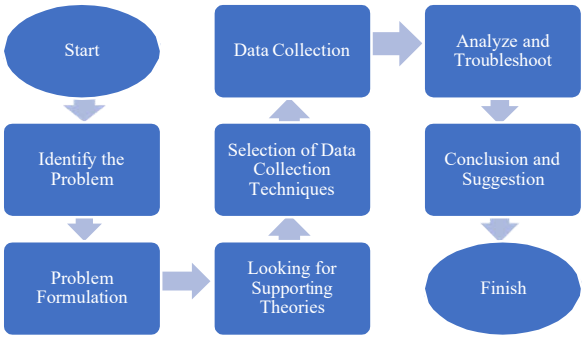

Figure 1 Research Design

Subject and Object of Research

Qualitative research methods treat participants as subjects and not objects because information from sources is very useful. They avoid being objectified by researchers who only answer prepared questions and choose answers that are already available [15]. In this study, the subject of the study was *Apron Movement Control* personnel at Sam Ratulangi International Airport Manado because they had the task of directly supervising and regulating the movement of aircraft on the *apron*.

The object of research can be people, objects or activities that have a certain type set by the researcher for the purpose of studying and drawing conclusions [16]. In this study, the object of research taken by the author is the suitability of stop line markings on the apron with applicable regulations to determine the effect on the safety of aircraft movements on the apron of Sam Ratulangi International Airport Manado.

Data Collection Techniques

Observation is part of data collection which means collecting data directly from the field. In qualitative methods, data is obtained by having to go directly into the field [15]. In this study, the author carried out observations on the air side of the airport, especially the apron area accompanied by AMC unit personnel when carrying out On the Job Training from January to March 2023.

Literature study or literature can be interpreted as a series of activities related to methods of collecting library data, reading, and recording and processing research materials [17]. The literature study conducted by the author includes rules and regulations to conduct reviews related to the causes of problems and become guidelines and guidelines for the understanding contained in the discussion of problems.

An interview is a face-to-face chat between the interviewer and the data source, and where the interviewer asks directly about an object that is studied and has been designed in advance [18]. In this study, the author used a semi-structured open interview technique

with Apron Movement Control personnel at Sam Ratulangi International Airport Manado.

2.1.1. Observation Guidelines

According to [19] Observation in qualitative research Researchers must first understand the variations of observations and the roles carried out by researchers. In this study, researchers made stop line markings on the parking stand of the apron of Sam Ratulangi International Airport Manado as an aspect to be observed.

Table 1 Observation Guidelines

No.	Indicator	Source
1.	Apron marking condition	Regulation of the Director General of Civil Aviation No. KP 326 of 2019; Annex 14 Vol I; ICAO *Doc 9157*; *Airport Marking & Sign Handbook ACI*
2.	The identification of aircraft type designation *markings* on the *stop line*	
3.	Use of *stop line* markings by aircraft	

Interview Guidelines

In this study, the author used a semi-structured interview technique that had compiled a list of questions. Therefore, the author has prepared interview guidelines for compiling interview research instruments. This interview is used to obtain information about what marks have non-compliance with applicable regulations and the effects arising from non-compliance with these marks.

Data Analysis Techniques

Data analysis techniques mean methods of processing data, compiling data and breaking it into smaller units to make it easier to understand and useful for finding solutions to a problem [15]. In qualitative research, data is obtained using various data collection techniques (triangulation), and is carried out continuously until the data is saturated [16].

Quoting from [20] in [16] suggests that qualitative data analysis activities are carried out interactively and continuously until complete. Activities in data analysis consist of data reduction steps, data display, and conclusion drawing/verification. Therefore, in this study the author uses data analysis techniques by Miles and Huberman where the author will look for quite a lot of data in the field then record and detail so that clearer data is obtained. Then the author will present data (display data) in the form of narrative text and also evidence in the form of images in order to understand what happened and make it easier to plan the next work. Finally, the author will conduct a conclusion drawing/verification based on the data that has been obtained and presented to get a conclusion. Conclusions in qualitative research may be able to answer the formulation of the problem formulated from the beginning, but may not be so.

RESULT AND DISCUSSION

At Sam Ratulangi International Airport Manado, the author found a problem when carrying out service in the AMC unit and then observed the markings on the apron. The observation made by the author on the air side was during the duty in the AMC unit. The problem is then sought for solution through literature studies and interviews to answer the formulation of the research problem.

Based on the results of the literature study conductedby the author, it includes rules and guidelines used to review things that cause problems regarding the discussion of existing problems.

Through this literature study, the author reviewed the relevant literature, namely regulations and guidelines on apron markings, especially related to stop line markings both through national and international regulations.

The guidelines used by the author as a data source areas follows:

1. Regulation of the Director General of Civil Aviation Number KP 326 of 2019 concerning Technical and Operational Standards of Civil Aviation Safety Regulations – Part 139 (Manualof Standard CASR – Part 139) Volume I Airport(Aerodrome)
2. Annex 14 ICAO – Aerodromes, Volume I Aerodrome Design and Operations Fourth Edition, 2004
3. ICAO Doc/ 9157 Aerodrome Design Manual Fifth Edition, 2021 Part 4 – Visual Aids
4. Airport Council International – Apron Markings & Signs Handbook Second Edition, 2007

Figure 2 Analysis of problems at parking stand 8

On parking stand 8, there are stop line markings that do not have identification as in points **b** and **c** and also one stop line mark with identification B737 but in placement that is not appropriate in actual conditions as shown in point **a**.

Figure 3 Parking of B737-900 aircraft does not match the actual stop line

This is supported by evidence of the findings of LionAir aircraft with registration PK-LJG type B737-900aircraft parked on a stop line that did not have identification.

The author also found a *Scoot* airline aircraft with flight number TR-216 registered 9V-TRW type A320 aircraft equivalent to B737 parked (*block on*) on a *stop line* that did not have identification.

This proves that the stop line identification for the B737/A320 is not in its actual place according to actual conditions.

According to [5] point 2.3.18:

"**Coding system for turn bars and stop lines.** Where an aircraft stand is used by two or three types of aircraft only, it is possible to indicate by a painted inscription the aircraft type for which each set of markings is intended. Where an aircraft stand is meant for several aircraft types, there may be a need to code the turn bars and stop lines to simplify the markings and to facilitate safe and expeditious manoeuvering of aircraft. There is, however, no agreed or widely used coding system. The coding system adopted should be such that pilots can understand and use it without difficulty."

In [4] point 5.2.13.10 mention that "**Recommendation.-** *If more than one turn bar and/or stop line is required, they should be coded*."

The literature study conducted by the author found that the problem at parking stand 8 was not in accordance with the applicable regulations, namely ICAO Doc. 9157 [5] point 2.3.18 and also Annex 14 – Aerodromes [4] point 5.2.13.10. The regulation explains that if an aircraft stand is used by two or three types of aircraft, identification according to aircraft type is required.

The recommendation to solve the problem in accordance with the regulation is in point a indicated by **Figure 2** by temporarily closing the B737 aircraft type designation mark on the first stop line using cloth tape for then removing the mark and repainting according to the type of aircraft needed. In point b, painting the new aircraft type designation mark for the B737/A320 aircraft type on the second stop line in accordance with the actual conditions of the use of the stop line. In point c can remove the third stop line mark or add a new aircraft type designastion mark according to the type of aircraft needed.

Figure 4 Analysis of problems at parking stand 9

On parking stand 9 found two stop line marshaller markings that have the same aircraft type design (B737). Two stop lines made on one aircraft stand are intended for several different aircraft types so that both stop lines

must be given identification of aircraft types according to their type to ensure the safety of aircraft movement to aircraft facilities such as laying aerobridges.

Figure 5 Parking of the A320 aircraft at parking stand 9

The author found that an AirAsia aircraft with registration PK-AZR with type A320 parked at parking stand 9 on the second stop line so that the first stop line was not suitable for type B737/A320 aircraft and had to be reidentified.

According to Apron Markings and Signs Handbook point 3.13, it mention about **multiple marshaller and towing stop line**, "The markings opposite should be used where an aircraft, either under power or tow, is positioned on stand by a marshaller, but in association with an air bridge or where fuel hydrant positions are critical, so that different nose wheel stop positions are needed for the different aircraft types to be accommodated." [3]

"Aircraft type designation must be yellow below the stop line. The letters should be legible to the marshaller facing the arriving aircraft as shown below." [2]

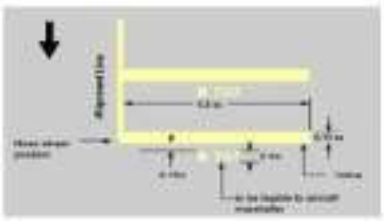

Figure 6 Regulation of the Director General of Civil Aviation No. KP 326 of 2019 point 5.2.13.15

Recommendations for solving the problem in accordance with the regulations, point A indicated by **Figure 4** by temporarily closing the B737 aircraft type designation markings on the first stop line using cloth tape for then removing markings and repainting according to the type of aircraft needed. In point b, repaint the aircraft type designation markings for the B737/A320 aircraft type on the second stop line according to actual conditions.

In this study, the author conducted a semi-structured interview with AMC personnel of Sam Ratulangi International Airport Manado to get answers to the formulation of research problems. This interview was conducted with 4 resource persons from AMC personnel, namely:

1. Victor Simamora (Bang Victor) – Team Leader AMC
2. Achmad Rizaldo Salau Fadin (Bang Aldo) – AMC Personnel Member
3. Riyo Sentosa (Bang Riyo) – AMC Personnel Member
4. Ahmad Rizqi Fauzi (Bang Kipau) – AMC Personnel Member

The interview was conducted by asking 6 question points as follows:

1. Are the stop line markings (parking stand 7, 8, 9) at Sam Ratulangi International Airport Manado in accordance with applicable regulations?
2. What do you think about the problem of *stop line* markings on *parking stands* 7, 8, 9?
3. What is the cause of the unsuitable marking condition?
4. How influential is the non-conformity of *stop line markings on* parking stands *7, 8, 9 on the safety of aircraft movement?*
5. Has there ever been *an incident*/*accident* caused by a discrepancy in the mark?
6. In your opinion, what is the solution to overcome the problem of *stop line markings* on the *apron* of Sam Ratulangi International Airport Manado?

Based on the results of the interview, the authorreceived an answer that the stop line markings on parking stands 7, 8, and 9 are still not in accordance with regulations, this is due to changes in the construction of the new terminal which causes the correct stop line position to be backward for new aviobridge adjustments, but has not been repainted the markings. Temporary handling, the AMC unit conducted a briefing with the marshaller team to adjust the aircraft's parking position to the current condition of the markings.

This marking discrepancy is quite influential on the safety of aircraft movement because it can cause an error in the inappropriate aircraft parking position in the right place. Parking position errors such as parking stand 8 can cause difficulties in the docking process and can pose a safety risk.

CLOSING

Conclusion

Based on the results of research related to the title and problems that the author has described in the previous chapter, several conclusions can be drawn as follows:

1. There is still a discrepancy between the stop line markings and the regulations applicable on the apron of Sam Ratulangi International Airport Manado, especially on parking stands 7, 8, and 9 with the regulations in the Regulation of the Director General of Civil Aviation No. KP 326 of 2019 concerning Technical and Operational

Standards of Civil Aviation Safety Regulations – Part 139 Vol I Airport, Annex 14 – Aerodromes, ICAO Doc. 9157 Aerodrome Design ManualPart 4 – Visual Aids, and Airports Council International – Apron Markings &; Signs Handbook.

2. The effect of aircraft stop line markings that are not in accordance with regulations and their placement is quite influential on the smoothnessof aircraft movement because it can cause errors in aircraft parking positions that are not suitable in the right place so that performance and service are less effective and can pose safety risks.

Suggestions

1. Evaluate stop line markings, especially on parking stands 7, 8, and 9 in accordance with applicable regulations.

2. Optimization of stop line markings*, especially on parking stands* 7, 8, and 9 for the short term by temporarily closing *aircraft type design* markings on the *wrong stop line* using *cloth tape* and also conducting *safety briefings* in the form of oral to every change of the *marshaller* team and writing in the form of information boards related to adjustments to the use of markers. Fora long-term solution, it can be done by removingold marks that are no longer suitable and then painting new marks in accordance with regulations.

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